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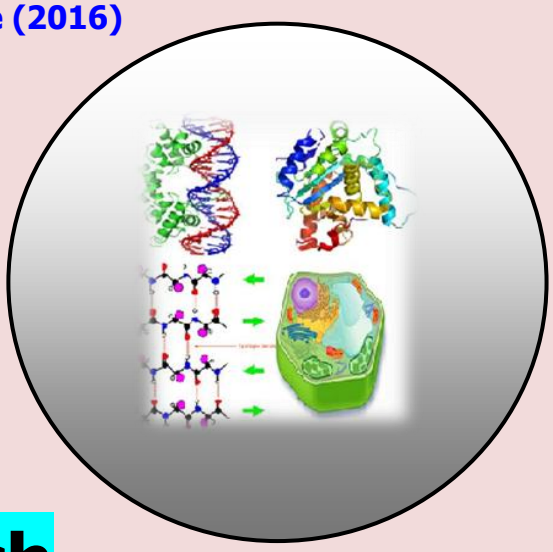

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RESEARCH PAPER

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Hazardous effects of Different Dose Regimens of Cement Dust on Mung Bean (*Vigna radiata*)

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ABSTRACT

Present study is carried to find out the toxic effects of cement dust on plant height, chlorophyll and protein content of mung bean (Vigna radiata). A pot culture experiment was performed where different doses of cement dust were mixed with garden soil. The mung bean plants showed significant deterioration in all above mentioned parameters. The study confirmed that decline in all the parameters is directly correlated with the different doses of cement dust. Maximum decline was observed at the highest toxic dose 250g/5kg. The growth and productivity of plants were severely affected.
Keywords: Toxic, Cement Dust, Mung Bean, Growth.

INTRODUCTION

Cement industries are one of the major sources of dust pollution as it produces a remarkable amount of cement dust which settles in nearby areas and vegetation. Cement dust contains a certain heavy metals such as chromium, cobalt, nickel, lead and mercury which are hazardous to the environment and posing threat to human health with a high magnitude. These industries play a vital role in the imbalances of the environment and produce air pollution hazards. The cement dust pollution causes alkalization of the ecosystem and changes in the chemical composition of soil. It affects the plants in various ways *i.e.* cement dust and cement crust on leaves plug stomata and interrupt absorption of light and diffusion of gases, lowering starch formation, reducing fruit setting (Lerman, 1972), inducing premature leaf fall (Czaja, 1962) and leading to stunted growth (Darley, 1966). Dust deposition affects photosynthesis, stomatal functioning and productivity (Santosh and Tripathi, 2008). The cement pollutants cause injury to plants either by direct toxic effect or modifying the host physiology rendering it more susceptible to infection (Gupta and Mishra, 1994). In severe cases of pollution, the injury symptoms were expressed as foliar necrosis or complete disappearance of the plant. Samal and Santra (2002) have also previously studied the impact of air pollution on plants with reference to foliar, anatomical and biochemical changes by experimenting on various sensitive plants. Increased concentrations of the above pollutants cause progressive reduction in the photosynthetic ability of leaves, closure of leaf stomata and mainly a reduction in growth and productivity of plants (Larcher, 1995).

In view of above mentioned pollution problem of cement dust, the present study was carried out to investigate the effect of cement dust on plant height, chlorophyll and protein content of mung bean (*V. radiata* L.) plants. Mung bean is widely grown in India as a source of protein.

MATERIALS AND METHODS

A soil pot culture experiment was undertaken to find out the effects of cement dust pollution on morphological and biochemical parameters of mung bean (*V. radiata)* plants. Experiment was carried out under glasshouse conditions. Different doses (50g/5Kg, 100g/5Kg, 150g/5Kg, 200g/5Kg, 250g/5Kg) of cement dust were mixed well with properly dried and sieved virgin garden soil. Cement dust free pots were treated as control. The experiment was performed in triplicate. Seeds were purchased from the authorized seed shop. Before sowing, seed surface were sterilized with 0.1 % mercuric chloride solution to prevent fungal infection and then washed with distilled water. Overnight soaked seeds were sown at the depth 1.5 inches with the help of rubber policeman rod. 20 seeds were sown in each pot. The height of the plant was measured from the border of the container to the top of the plant stem. It was expressed in centimeters (cm). Chlorophyll (Chl) and carotenoids (Car) in leaves were extracted in 80 % acetone by the method of Arnon (1949) and protein was assayed according to the method of Lowry *et al*., (1951).

Data were analyzed statistically. Average mean and standard error was calculated. LSD at $P \leq 0.05$ and $P \leq 0.01$ levels to determine the significant differences and percentage decrease over control were also calculated.

RESULT

Plant height was significantly reduced. The reduction was recorded by 41.41, 44.53 and 51.56 % at 150g/5kg, 200g/5kg, 250g/5kg treatments of cement dust respectively during I week. It was also found to be significantly reduced by 34.46, 43.50, 46.33, 49.15 and 51.98 % during II week at all the respective doses. A significant decrease of 32.02, 44.74, 49.56 and 55.26 % in plant height was observed at 100g/5kg, 150g/5kg, 200g/5kg, 250g/5kg treatments respectively in III week. A significant reduction was observed in plant height at all dose regimens during IV and V weeks of growth. During VI week significant reduction of 41.75, 45.50 and 54.25 % was found at 150g/5kg, 200g/5kg, 250g/5kg treatments respectively. Maximum significant decrease was observed as 60.0 % in V week at 250g/5kg cement dust throughout the observations.

Photosynthetic pigments in mung bean (*V. radiata*) plants was decreased at 30^{th}, 60^{th} and 90^{th} day when exposed to various doses of cement dust. Chlorophyll **'**a' was recorded as 1.73, 1.99 and 1.90 mg g^{-1} FW at 30^{th}, 60^{th} and 90^{th} day in control plants. It was significantly reduced as 42.77, 37.18 and 58.42 % at 250g/5kg cement dose at 30^{th}, 60^{th} and 90^{th} day respectively. Chlorophyll **'**b' was recorded as 1.39, 1.60 and 1.11 mg g^{-1} FW at 30^{th}, 60^{th} and 90^{th} day in control plants. It was significantly reduced as 52.52, 36.87 and 36.04 % at 250g/5kg cement dose at 30^{th}, 60^{th} and 90^{th} day respectively. Total chlorophyll content was recorded as 3.22, 3.72 and 3.15 mg g^{-1} FW at 30^{th}, 60^{th} and 90^{th} day in control plants. It was significantly reduced as 47.83, 35.75 and 24.13 % at 250g/5kg cement dose at 30^{th}, 60^{th} and 90^{th} day respectively. Carotenoids content was recorded as 0.69, 0.93 and 0.76 mg g^{-1} FW at 30^{th}, 60^{th} and 90^{th} day in control plants. It was significantly reduced as 55.07, 58.06 and 48.68 % at 250g/5kg cement dose at 30^{th}, 60^{th} and 90^{th} day respectively.

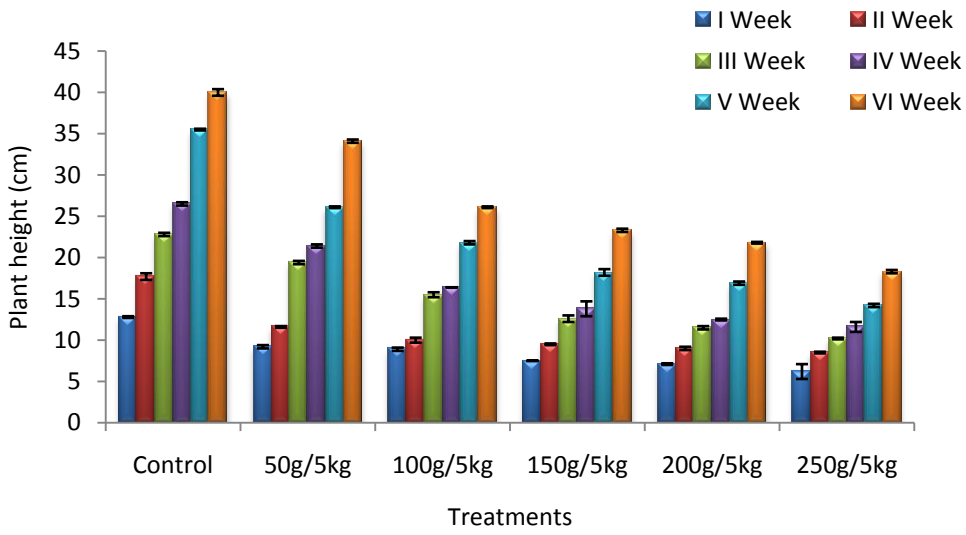
Protein content in seeds was found to be significantly decreased with the increasing doses of cement dust. It was recorded as 46.70 mg g^{-1} DW in control plants. Maximum significant decrease in protein content was observed as 19.06 % at 250g/5kg treatment over control. Protein content in leaf tissue was also found to be significantly decreased with the increasing doses of cement dust. It was recorded as 4.36, 4.51 and 3.44 mg g^{-1} FW in control plants at 30^{th}, 60^{th}, 90^{th} days respectively. Maximum significant decrease in protein was observed as 3.67, 5.54 and 4.94 % at 250g/5kg treatment over control at 30^{th}, 60^{th}, 90^{th} days respectively.

DISCUSSION

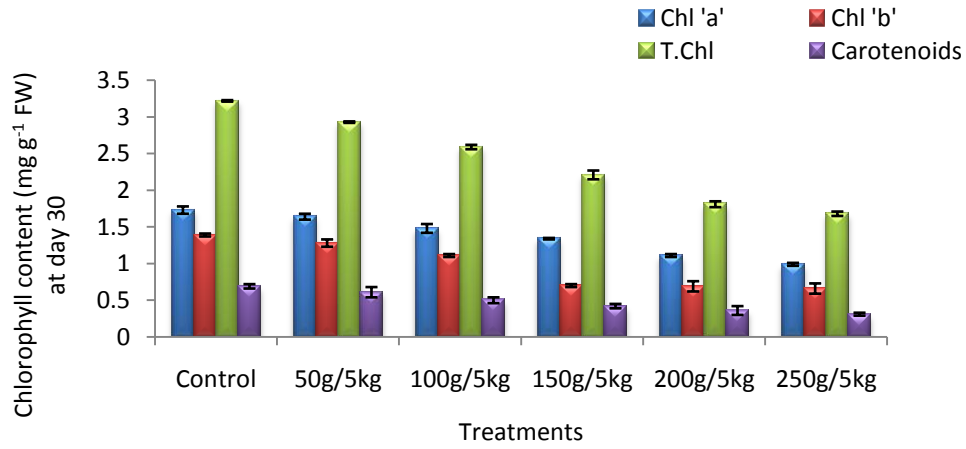
Incorporation of cement dust with soil changes its nature and makes it alkaline. Alkalization and high amount of Ca^{++} content in cement polluted soil inhibits the assimilation of Mg, Mn and Fe by plants (Mandre and Tuulmets, 1997). *V. radiata* an importat leguminous crop is severely affected by cement dust. Plant height of *V. radiata* plants was significantly reduced. Decrease in plant height with increasing doses were observed which might be due to the decrease in the net primary production and chlorophyll content in response to cement air pollution, confirming the earlier findings of Prasad & Inamdar (1990) in *V. mungo* (black gram).

Pigment synthesis was reduced in *Vigna radiata* when it was exposed to different doses of cement dust. The pollutants can cause reduction in the concentration of photosynthetic pigments *viz.* chlorophyll and carotenoids which directly affect the plant productivity. Chlorophyll 'a', 'b', total chlorophyll and carotenoid content were also decreased as compared to control plants. Nanos and Ilias (2007) reported that cement dust decreased the total chlorophyll content and chlorophyll a/b ratio.

This may result in decreased photosynthetic rate and quantum yield. Decrease in chlorophyll content might be due to the chloroplast damage by incorporation of cement dust into leaf tissues (Singh and Srivastava, 2002). Carotenoids together with light-antenna functioning protect the photosynthetic apparatus against stress by scavenging the active oxygen (Strzhalka *et al.,* 2003). However, the reduction in various growth attributes in treated plants could be due to synergistic effect of various pollutants on metabolic processes which inhibit many enzyme systems of plants (Singh *et al.,* 2007). On the basis of this study, it could be concluded that the growth and metabolism of plants used to be adversely affected if grown in cement dust mixed soils possibly due to the presence of toxic pollutants in cement dust. The chloroplast damaged by incorporation of cement dust into the leaf tissue caused reduction in the chlorophyll concentration in the dusted leaves. This has also been reported by Singh and Rao (1981). Chlorophyll content is essential for the photosynthetic activity and reduction in chlorophyll content has been used as an indicator of air pollution. The present findings are in accordance with Saha and Padhy (2011) who also observed the decline in chlorophyll 'a' and 'b' contents in *Shorea robusta* and *Madhuca indica* when their foliages were treated with stone crushing dust pollutants.



Effect of different doses of cement dust on plant height of mung bean (*V. radiata)* plants



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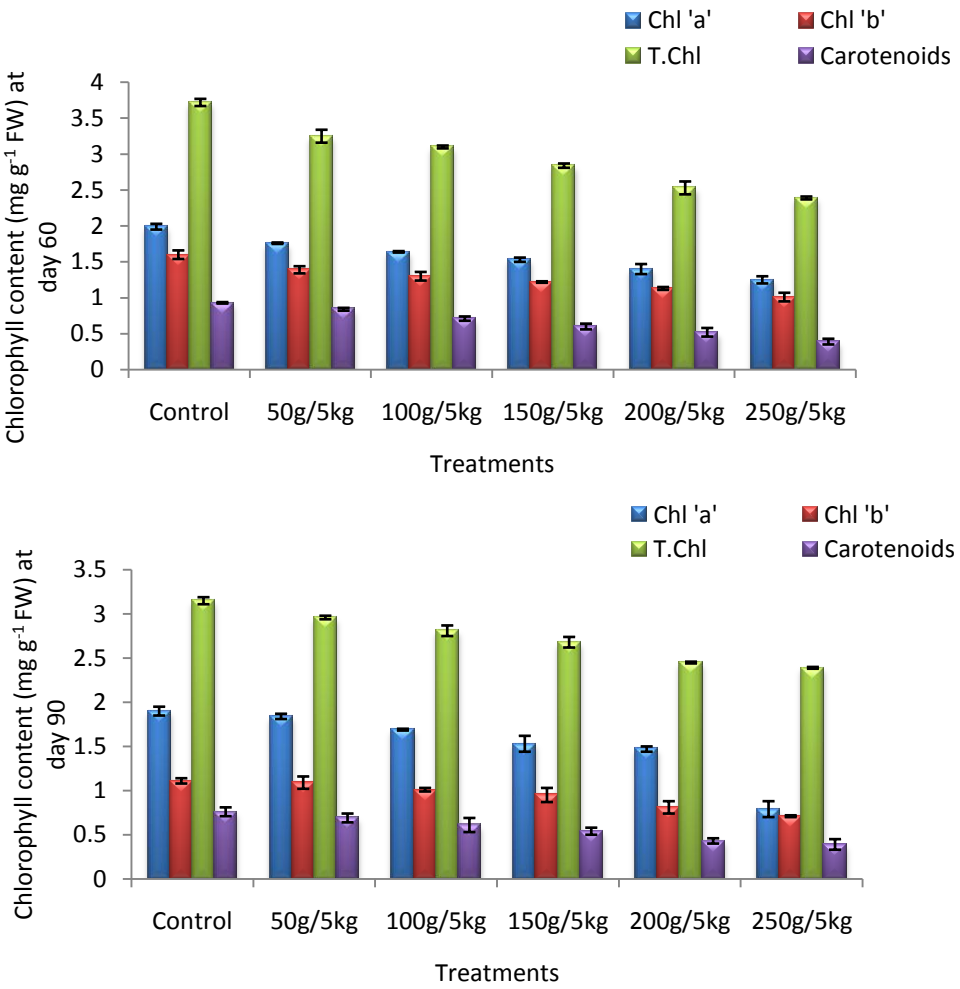
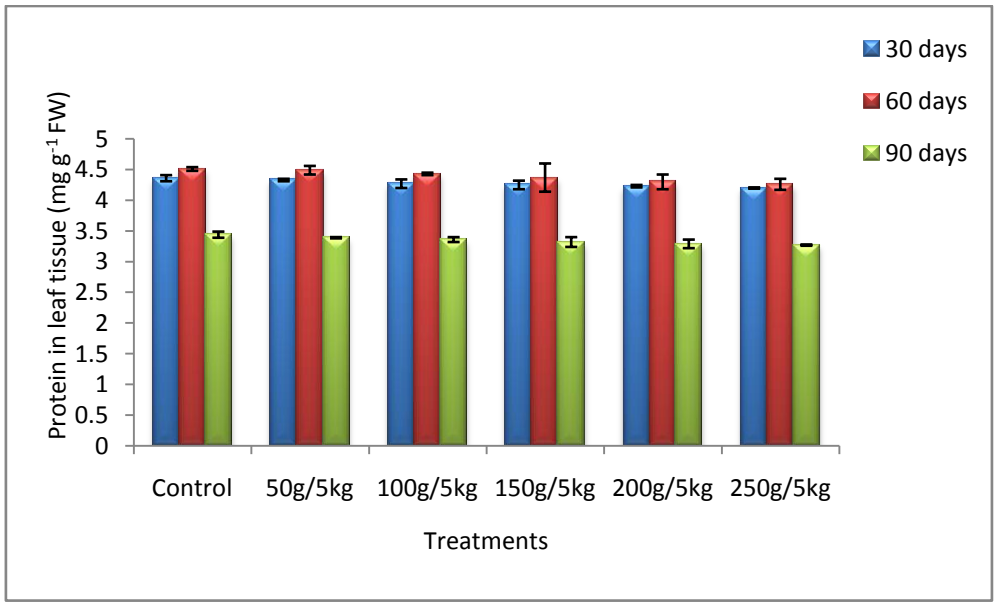
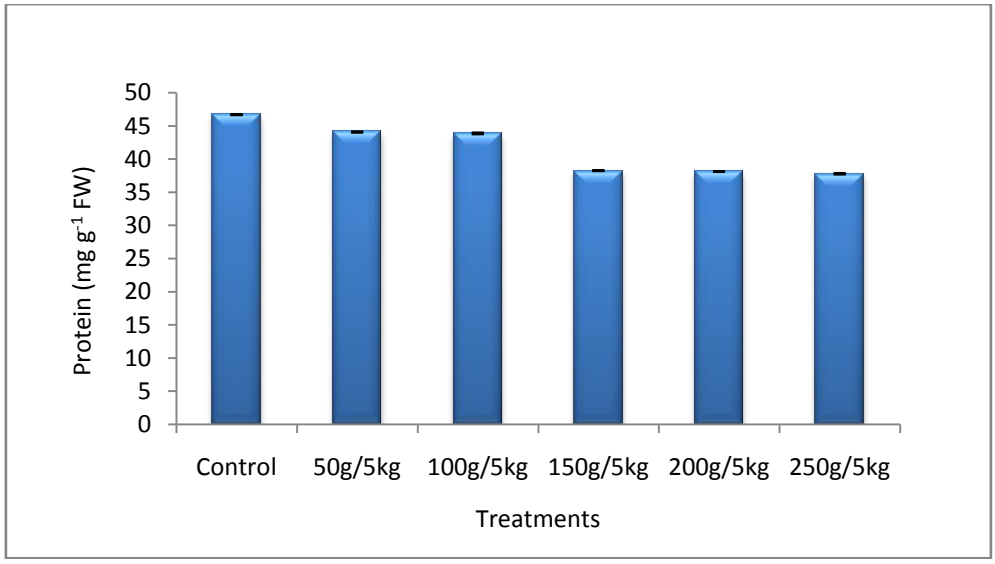


Effect of different doses of cement dust on chlorophyll content of mung bean (*V. radiata)* plants



Effects of different doses of cement dust on protein content in leaf tissue of Mung bean (*V. radiata)* Plants.



Effects of different doses of cement dust on protein content in seeds of Mung bean (*V. radiata)* Plants

Protein content was also found to be decreased significantly in both leaf and seeds of mung bean plants. Reduction in protein content might be due to the enhanced rate of protein de-naturation (Tripathi and Gautam, 2007). The enhanced protein de-naturation and breakdown of existing protein to amino acid is the main cause of reduction in protein content (Constantinidou and Kozlowski, 1979). One of the major effects of the heavy metals on plants is reported to be a decrease in the protein content by hindering protein synthesis. Lead, zinc and cadmium in *Hordeum vulgare* plants (Stiborova *et al.,* 1986 a), copper and lead in *Zea mays* (Stiborova *et al.,* 1986 b), lead and cadmium in *Lemna minor* (Mohan and Hosetti, 1997) have been reported to decrease protein contents. Trivedi and Singh (1995) noticed significant reduction in protein content in few plants as a result of fly ash particulates. Williams and Banerjee (1995) found considerable reduction in protein in leaves of *Mangifera indica* and *Shorea robusta* affected by emissions from a nearby thermal power plant.

CONCLUSION

This is now clearly evident that exposure to cement dust is causes significant reductions in plant height, chlorophyll and protein content of mung bean plants. Surely other plants and living beings in the cement dust pollution vicinity will experience similar problems. To protect us from cement dust pollution such industries should be distant from residential areas and their pollution must be checked by appropriate methods and technologies.

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